PREPRODUCTION TESTING OF THE FAIREY AVIATION MN-1A PRACTICE BOMB DISPENSER

by

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Test Directorate
AIR FORCE SPECIAL WEAPONS CENTER
Air Force Systems Command
Kirtland Air Force Base
New Mexico

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ERRATUM

AFSWC TDR-63-62. PREPRODUCTION TESTING OF THE FAIREY AVIATION MN-1A PRACTICE BOMB DISPENSER

Page 15, figure 4: Change caption to read "Shock test apparatus."

ABSTRACT

Testing of the Fairey Aviation Corporation MN-1A Trainers was performed by AFSWC at the request of the Royal Canadian Air Force, for the purpose of establishing the Fairey Aviation Corporation as a qualified producer of the MN-1A Trainer. The tests were made in general accordance with Mil-T-25812A and Mil-E-5272C, and included vibration, acceleration, and shock testing, and exposure to certain climatic conditions critical to the operation of the dispensers. Three sample trainers, numbered FAC-1, FAC-2, and FAC-3, were used. To expedite testing, each of the samples was subjected to a portion of the specified test requirements. The tests indicated a need for a number of improvements in the original design.

PUBLICATION REVIEW

This report has been reviewed and is approved.

ALBERT L. HALEY
Colonel USAF
Director, Test Directorate

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1. INTRODUCTION.

a. Purpose.

The purpose of these tests was to determine if the samples submitted by the contractor met the requirements of Military Specification Mil-T-25812A.

b. Authority.

The authority for this test is contained in AFSC form 124 for Project 921X, Task 021500B, entitled "Support to RCAF." This authority was issued by Headquarters, Air Force Special Weapons Center, Kirtland Air Force Base, New Mexico on 20 July 1962.

2. SUMMARY OF TEST.

a. Description of test article.

The MN-1A Trainers used in these tests were manufactured by the Fairey Aviation Corporation, Dartmouth, Nova Scotia, Canada. The MN-1A Trainer is an airborne practice bomb-carrying device used primarily for the training of aircraft pilots in the delivery of special weapons. With modifications of the electrical system, it is also used for general purpose bombing practice. The MN-1A Trainer is carried externally on subsonic, transonic, and supersonic aircraft. The trainer carries six practice bombs (either the MB-1, MB-2, or the MK-76 Mod 2) which are ejected one at a time by the pilot, enabling him to make six practice runs at a target during one flight. The trainer, with the nose section and tail cone installed, is 156.25 inches in length with a diameter of 17 inches. When unloaded, the weight is 470 pounds. The structure assembly consists of a case composed of three parts: a conical nose section in which accessories are stowed; a cylindrical center section,

containing two bomb bays with doors, which houses the bomb ejector mechanisms, relay box, and door actuating mechanism; and a two-piece truncated tail section.

b. List of tests conducted:

(1) Functional.
(2) Vibration.
(3) High altitude.
(4) Salt spray.
(5) Acceleration.
(6) Humidity.
(7) Low temperature.
(8) High temperature.
(9) Sand and dust.
(10) Shock.
(11) Temperature shock.

c. Description of tests conducted.

(1) Functional.

(a) A functional test using one of the MN-1A trainers revealed that, when a connection was made at the forward electrical connector, the trainer functioned properly. However, when the aft connector was used, the bombs failed to eject. A representative of Machine Products Company, Albuquerque, New Mexico was consulted in regard to this failure and it was learned that the wiring diagram specified in Mil-T-25812A was in error. This error was corrected and the trainer functioned properly.

(b) Functional tests were performed with all three trainers using both MK-76 and MB-2 practice bombs. The functional test of FAC-1 using MB-2 bombs resulted in failure of the trainer to release the bomb in the No. 2 position. However, with the MK-76 bombs, the trainer released properly in all six positions. No explanation for this failure to release can be offered. Testing of the FAC-2 and FAC-3 trainers using MK-76

and MB-2 bombs revealed no failures.

(2) Vibration.

(a) A vibration test of the Fairey Aviation MN-1A trainer No. FAC-2 was performed in accordance with Mil-E-5272C. For this test, the trainer was mounted on a mockup of a 30-inch suspension system. The mockup incorporated two sway braces on each side of the trainer on 20-inch centers located midway between the suspension lugs and at an angle of 20.7° from the vertical plane passing through the trainer axis. The trainer and fixture were suspended from an inverted 25,000-pound Ling-Temco vibration exciter (figure 1). The trainer was loaded with six MK-76 bombs for this test.

(b) Instrumentation for the test consisted of two accelerometers, one mounted just aft of the forward suspension lug and the other mounted in the center of the vertical shear panel inside the trainer. To allow mounting of the second accelerometer, the doors of the trainer were left partially open during the vibration test. Vibration inputs were controlled by the acceleration measurements made near the suspension lug.

(c) A resonance survey was performed to determine the resonant frequencies of the trainer. This survey consisted of varying the frequency of applied vibration slowly through the range of 10 to 34 cycles per second. Approximately 1 hour was required for this survey. The only significant resonant frequency was 29 cycles per second. The trainer was vibrated at this frequency for a period of 10 hours.

(d) Although considerable amplification of the vibration input to this trainer was measured on the vertical shear panel, examination of this panel following the 10-hour vibration test revealed no damage. Examination of other parts of the trainer revealed no damage as a result of the test. All six miniature bombs fired successfully upon completion of the test.

(e) It is concluded that the MN-1A Trainer No. FAC-2, as submitted for testing, satisfactorily withstood the vibration test required by Mil-T-25812A.

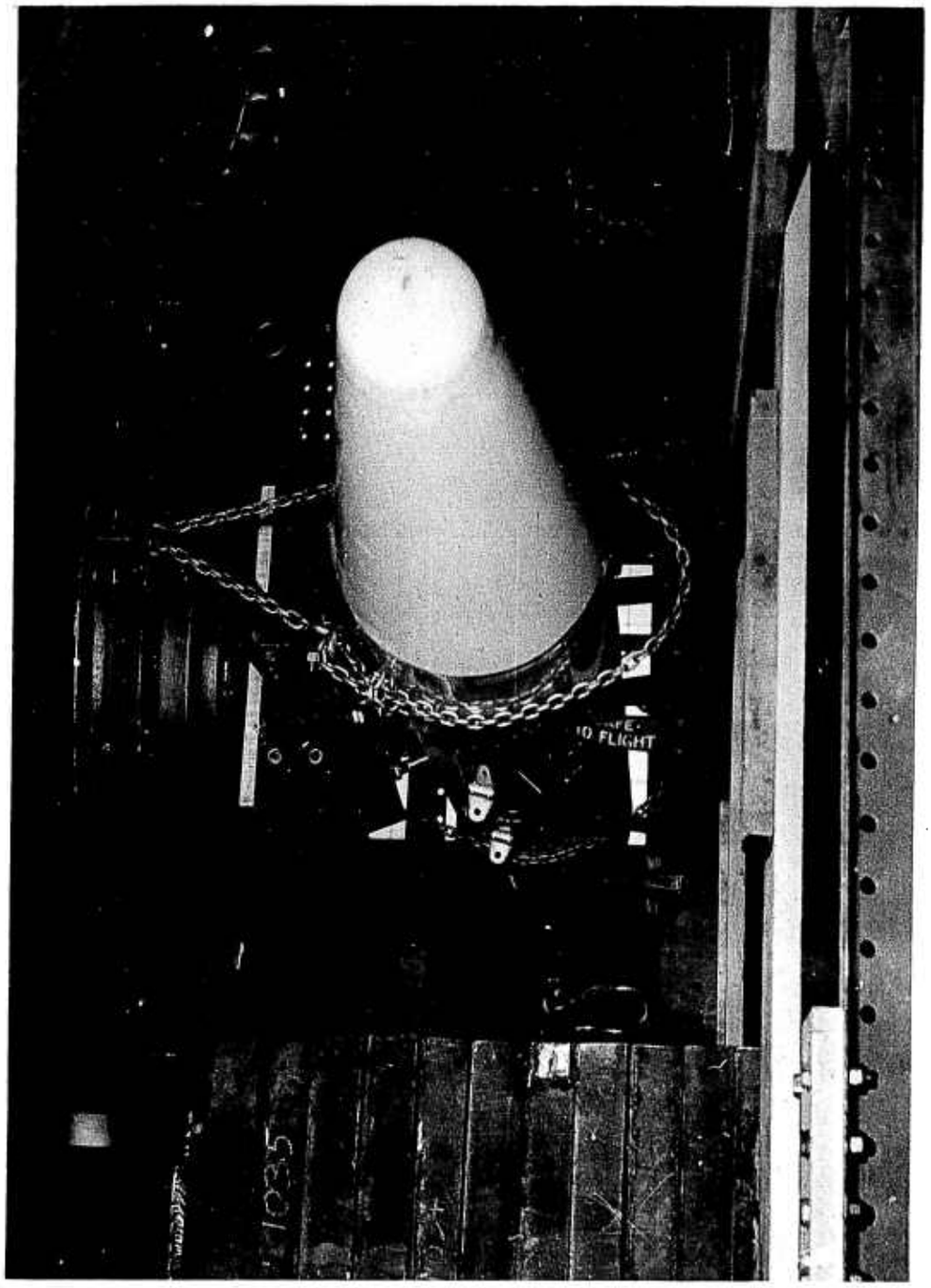

Figure 1. The MN-1A Trainer mounted on the Ling-Temco, 25,000-pound Vibration Exciter

(3) High altitude.

(a) MN-1A Trainers FAC-2 and FAC-3 were exposed to simulated high altitude environments and operated under these conditions to test their ability to function in high altitude flight. Two such tests were performed with six MK-76 bombs loaded in the Trainer. Unit FAC-2 was used for the first test, and units FAC-2 and FAC-3 were used for the second test.

(b) For the first test, the FAC-2 was placed inside a temperature-altitude chamber (figure 2), the temperature lowered to -65°F, and the barometric pressure lowered to 3.44 inches of mercury.

(c) After 1 hour exposure at the simulated high altitude conditions, a functional test of the trainer was performed in accordance with par. 4.5.3.2 of Mil-T-25812A. The bomb in position No. 1 released satisfactorily and the doors functioned properly. Attempts to release bombs in positions 2, 3, 4, 5, and 6 failed.

(d) The trainer was removed from the chamber and allowed to remain overnight. An examination revealed that the stepping switch had not moved from position No. 1. The trainer was reloaded and a functional test performed. All six bomb positions released properly. (It was later determined that freezing of the rubber grommet on the shaft of the stepping switch prevented proper operation of this switch.)

(e) As a result of this failure, trainer No. FAC-3 was modified by representatives of the Fairey Aircraft Corporation. The modification included the following:

1 Modification of the release cams.

2 Replacement of the stepping switch with a Ledex Model B-62-557-A.

3 Application of dry film lubricant to all moving parts on the ejector base assembly (lubricant used was Molub-Alloy No. 369 manufactured by Imperial Oil and Grease Company, Los Angeles 48, California).

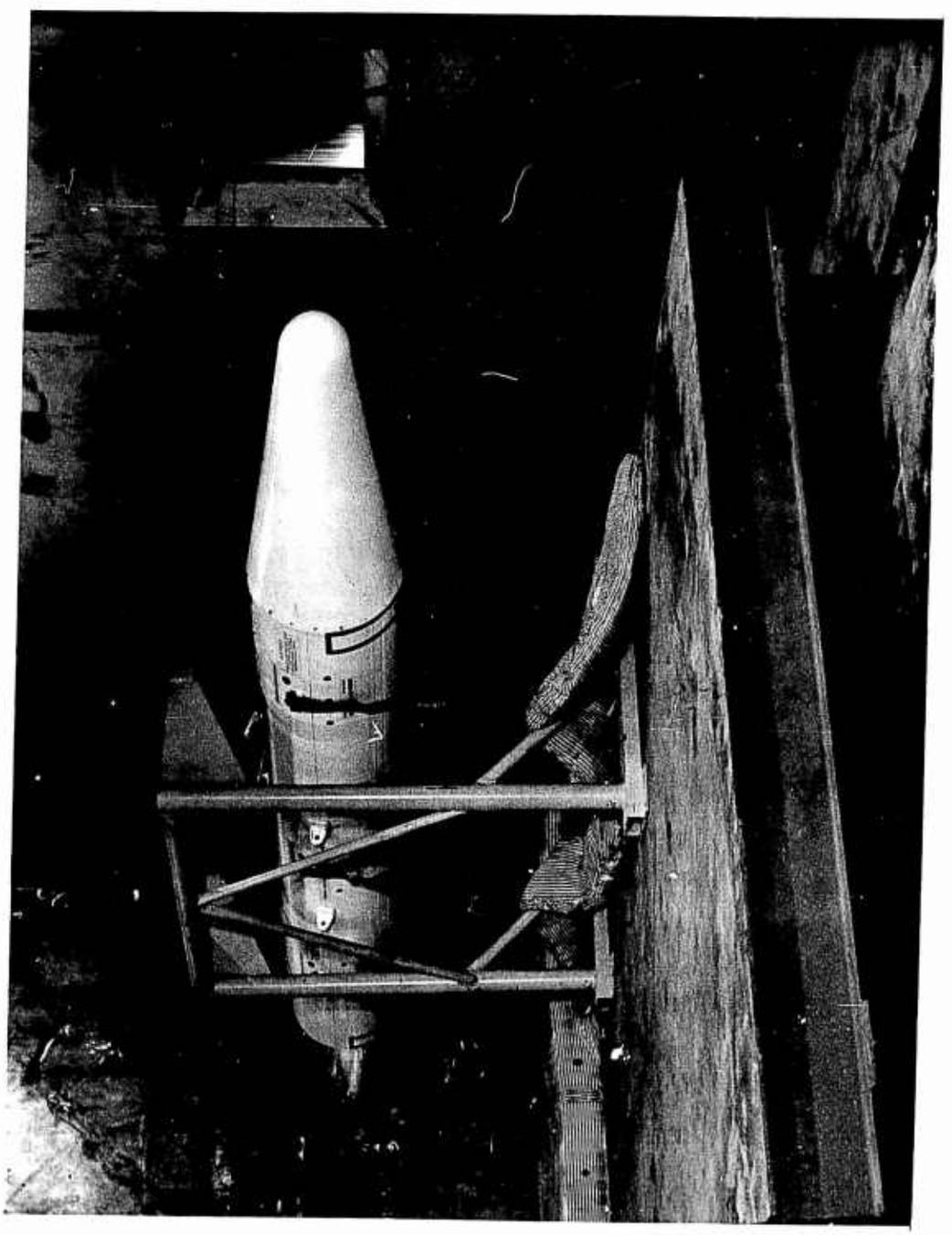

Figure 2. High altitude test

4 Removal of the rubber grommet on the shaft of the stepping switch.

(f) Since failures at low temperature were suspected to result at least in part from the rubber grommet on the stepping switch, it was determined jointly by Fairey Aviation personnel and the RCAF Materiel Representative that this grommet should be removed. To prove the theory that this grommet was the cause of the failure, it was removed from Trainer FAC-2 which had previously failed in the altitude test. Trainers FAC-2 and FAC-3 were then both subjected to the temperature and altitude conditions mentioned above. Upon conclusion of this second test, both trainers successfully completed the functional test and operated in a satisfactory manner.

(g) As a result of the above mentioned tests, the following conclusions were made:

1 The MN-1A trainer, as originally submitted for testing, is not satisfactory for operation at high altitude.

2 The rubber grommet on the stepping switch is the probable cause of failure in high altitude testing.

3 The MN-1A trainer, as modified by Fairey Aviation Corporation and submitted for testing, can be expected to operate satisfactorily under the environmental conditions imposed by the altitude test required in Mil-T-25812A.

(4) Salt spray.

(a) MN-1A Trainer No. FAC-2 was subjected to a salt spray test designed to simulate prolonged exposure in an area near a large body of salt water where salt spray is encountered in the atmosphere. This test was in compliance with the salt spray test described in Procedure I of Mil-E-5272C. The trainer was loaded with six MK-76 bombs and operated before being placed in the salt spray chamber.

(b) The apparatus used for this test included an exposure chamber designed to circulate a salt spray on the test article in such a

manner that liquid would not impinge directly on any portion of the article (figure 3) The temperature of the chamber was controlled at 95°F and the relative humidity was maintained between 95 and 98 percent. The solution used was a 5-percent salt solution containing a low nickel and copper content.

(c) The trainer was exposed to the salt spray test for a period of 50 hours. At the end of the exposure period, the trainer was removed and operated. No failures occurred as a result of this test. Examination of the trainer revealed no damage resulting from the salt spray exposure.

(d) The MN-1A Trainer, as submitted for testing, is considered to have satisfactorily withstood the salt spray test prescribed in Mil-E-5272C and required by Mil-T-25812A.

(5) Acceleration.

(a) An acceleration test was performed on MN-1A Trainer No. FAC-2. Although this test was based on the acceleration test specified in Mil-T-25812A, deviations from the procedures described in this specification were made because of the lack of a practical means of rotating the test item during acceleration as specified.

(b) For the acceleration test, the trainer was mounted on a mockup of a 30-inch suspension system. The mockup incorporated two sway braces on each side of the trainer on 20-inch centers located midway between the suspension lugs, and at an angle of 20.7° from the vertical plane passing through the trainer longitudinal axis. This fixture, with the trainer installed, was mounted on a centrifuge in such a manner as to impose the necessary accelerations in the proper directions. For each portion of the test, the trainer was operated at a speed which would impose an 8g acceleration through the center of gravity of the trainer. The centrifuge was then allowed to remain at this speed for a period of 60 seconds. Accelerations were imposed as follows:

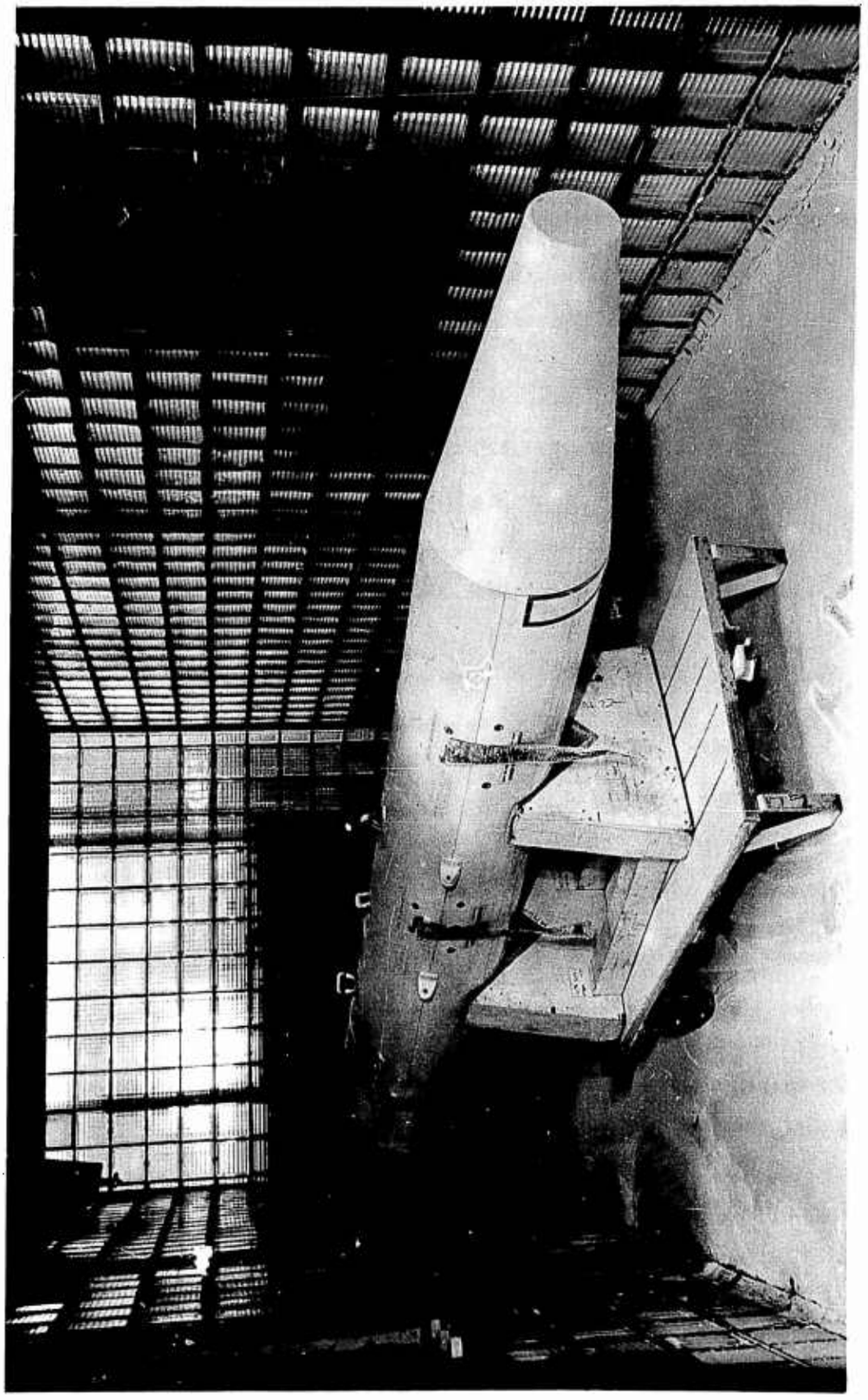

Figure 3. Trainer No. FAC-2 at the conclusion of the salt spray test

1 Downward along the vertical axis of the trainer.

2 Through the lateral axis of the trainer to the right.

3 Along the longitudinal axis of the trainer in the forward direction.

(c) Following this test, the trainer was operated by releasing all six bombs. No failures occured and no damage was observed as a result of this test.

(d) The MN-1A Trainer, as submitted for testing, is considered to have satisfactorily withstood the acceleration test imposed upon it and is considered to be within the standards intended by specifications required in Mil-T-25812A.

(6) Humidity.

(a) Humidity tests of the MN-1A trainer were performed both on FAC-2 and FAC-3.

(b) Before testing, both trainers were loaded and checked out to assure proper operation.

(c) Trainer No. FAC-1 was subjected to the humidity environment described in Mil-T-25812A. After 50 hours exposure to these environmental conditions, the trainer was operated in accordance with par. 4.5.3.2 of this specification. The trainer responded as follows:

1 With the Ledex switch in position 1, the bomb at station 1 released. However, the doors failed to close. The Ledex switch stepped to position 2.

2 With the cycling switch in position 2, the bomb in station 2 released and the doors closed. The Ledex switch failed to step to positions 3, 4, and 5, and required manual actuation.

3 With the stepping switch on position 6, the trainer operated satisfactorily.

(d) Trainer No. FAC-3, after modification by Fairey Aviation, was subjected to the humidity environments specified in

Mil-T-25812A. After approximately 150 hours exposure to these environments, an attempt was made to operate the trainer as specified. Although the doors and Ledex switch functioned properly during this portion of the test, a release of the ejector mechanism occurred only at station 3. The trainer was allowed to remain under atmospheric conditions for 7 days and another attempt made to obtain electrical releases. No releases occurred. The ejectors were released manually.

(e) Ejector mechanisms were removed from three of the stations which had failed during the humidity test. One of these mechanisms was lubricated with Mil-G-3278 low and high temperature grease. Another was modified by replacing the linkage springs with locally manufactured springs having a higher spring constant. The remaining mechanism was unmodified. These units were loaded with MK-76 practice bombs and exposed to the humidity environments required for the MN-1A trainer for a period of 8 days. After this exposure, the specimens were removed and suspended on a frame. A 28VDC pulse from a regulated 1500 amp power supply was applied to the solenoids of these mechanisms. Both the specimen which had been lubricated and the specimen on which the springs had been replaced functioned satisfactorily. The unmodified specimen failed to release.

(f) It was concluded, as a result of these tests, that the MN-1A trainers, as submitted for testing by Fairey Aviation, do not meet the requirements of Mil-T-25812A. It was determined that the failures which occurred were due to improper functioning of the release linkages after even small deposits of corrosion had formed on them. It was demonstrated that, by lubricating these linkages or by increasing the stiffness of the linkage springs, these mechanisms may be expected to function properly.

(7) Low temperature.

(a) MN-1A Trainers FAC-2 and FAC-3 were subjected to the low temperature test prescribed in Procedure I of Mil-E-5272C. Functional tests were performed on both trainers before exposure to the low temperature environment. The failure of trainer FAC-2 in the high

altitude test was attributed to freezing of the rubber grommet on the shaft of the Ledex stepping switch in the trainer. For this reason, the rubber grommets on both FAC-2 and FAC-3 were removed before testing.

(b) The trainers were placed in the chamber and the temperature lowered to -80°F. This temperature was maintained for a period of 72 hours. After this time, the trainers were operated.

(c) Trainer FAC-3 functioned satisfactorily. However, in trainer FAC-2 (unmodified), the bombs in stations 3 and 5 failed to release. Repeated efforts to release these stations failed.

(d) The temperature in the test chamber was then raised to -65°F and the trainers were allowed to remain at this temperature for a period of 24 hours. The FAC-3 was then operated in accordance with par. 4.5.3.2 of Mil-T-25812A. All stations released properly. No attempt at further testing of trainer No. FAC-2 was made.

(e) It was concluded from the results of this test that the MN-1A trainer, as originally submitted for testing, does not satisfactorily meet the requirements of Mil-T-25812A for operation after exposure to low temperature environments. However, the MN-1A trainer as modified and resubmitted for testing does meet these requirements.

(8) High temperature.

(a) MN-1A Trainer No. FAC-3 (before modification) was subjected to the temperature conditions in par. 4.1.2 of Mil-E-5272C. The test prescribed in Mil-T-25812A was not performed, since Procedure I of Mil-E-5272 has been discontinued. A functional test of the trainer was performed before it was exposed to the high temperature environment.

(b) The trainer was placed within the high temperature test chamber and the internal temperature raised to 160°F. After 25 hours at this temperature, the trainer was operated in accordance with par. 4.5.3.2 of Mil-T-25812A.

(c) Stations 1, 2, and 4 of the trainer released satisfactorily. Stations 3, 5, and 6 failed to release. Repeated efforts to obtain normal

electrical releases on the trainer failed. The trainer was then allowed to cool for 12 hours and an attempt was made to operate it. This attempt also failed. The stations were then released manually.

(d) The trainer was modified by Fairey Aviation Factory personnel and the high temperature test repeated. It was operated after 25 and 50 hours and functioned satisfactorily.

(e) It was concluded from these tests that the MN-1A trainer, as originally submitted for testing, does not meet the requirements of Mil-T-25812A for resistance to high temperature. However, the trainer, as modified and resubmitted for testing, will satisfy these requirements.

(9) Sand and dust.

(a) Sand and dust testing was performed on MN-1A trainer No. FAC-3 to simulate prolonged exposure to desert atmospheres. This test was performed in accordance with Mil-E-5272C. Before testing, the trainer was operated to assure that it was in proper working order.

(b) The trainer was placed in a sand and dust chamber and the dust density maintained between 0.1 and 0.5 grams per cubic foot. The sand and dust used for this test conformed to the specifications described in par. 4.11 of Mil-E-5272C. The air velocity in the chamber was maintained at 2500 ± 500 feet per minute throughout the test. Relative humidity in the chamber was maintained at less than 30 percent throughout the test.

(c) For the first 6 hours of testing, the internal temperature of the test chamber was maintained at 77°F. After 6 hours, the chamber temperature was raised to 160°F and this temperature maintained for 6 hours. The total period of the test was 12 hours. At the end of this exposure period, the equipment was removed and allowed to cool at room temperature. Accumulated dust was brushed away and the trainer was operated. No failures occurred as a result of this test.

(d) The MN-1A trainer, as submitted for testing, is considered to have satisfactorily withstood exposure to the sand and dust environment test required by Mil-T-25812A.

(10) Shock.

(a) For the shock test, the trainer was loaded with six MK-76 Mod 2 practice bombs and suspended from a mockup which simulated a 30-inch aircraft suspension system. This mockup incorporated two sway braces on each side of the trainer. These sway braces were on 20-inch centers located midway between the suspension lugs and at an angle of 20.7° from the vertical plane passing through the trainer longitudinal axis. The mockup was suspended from a hinged frame capable of being dropped to impose the desired shock intensity and duration (figure 4).

(b) The trainer was subjected to a total of 18 impact shocks of 15 g's acceleration, each shock impulse having a time duration of approximately 11 milliseconds. The maximum acceleration in each case was reached in approximately 5½ milliseconds. The shocks were applied in the following directions:

1 Vertically -- three shocks in each direction.

2 Parallel to the major horizontal axis -- three shocks in each direction.

3 Parallel to the minor horizontal axis -- three shocks in each direction.

(c) Following each series of shocks, the trainer was operated to determine if the bombs would release properly. All bombs released satisfactorily in each case and no damage was observed as a result of this test.

(d) The MN-1A trainer, as submitted for testing, is considered to have satisfactorily withstood the shock test prescribed in Mil-E-5272C and required by Mil-T-25812A.

(11) Temperature shock.

(a) Temperature shock testing was performed on MN-1A trainer No. FAC-2. This trainer had previously failed in low temperature testing but was checked out and determined to have recovered from the detrimental effects of this exposure. As a result of previous findings, it

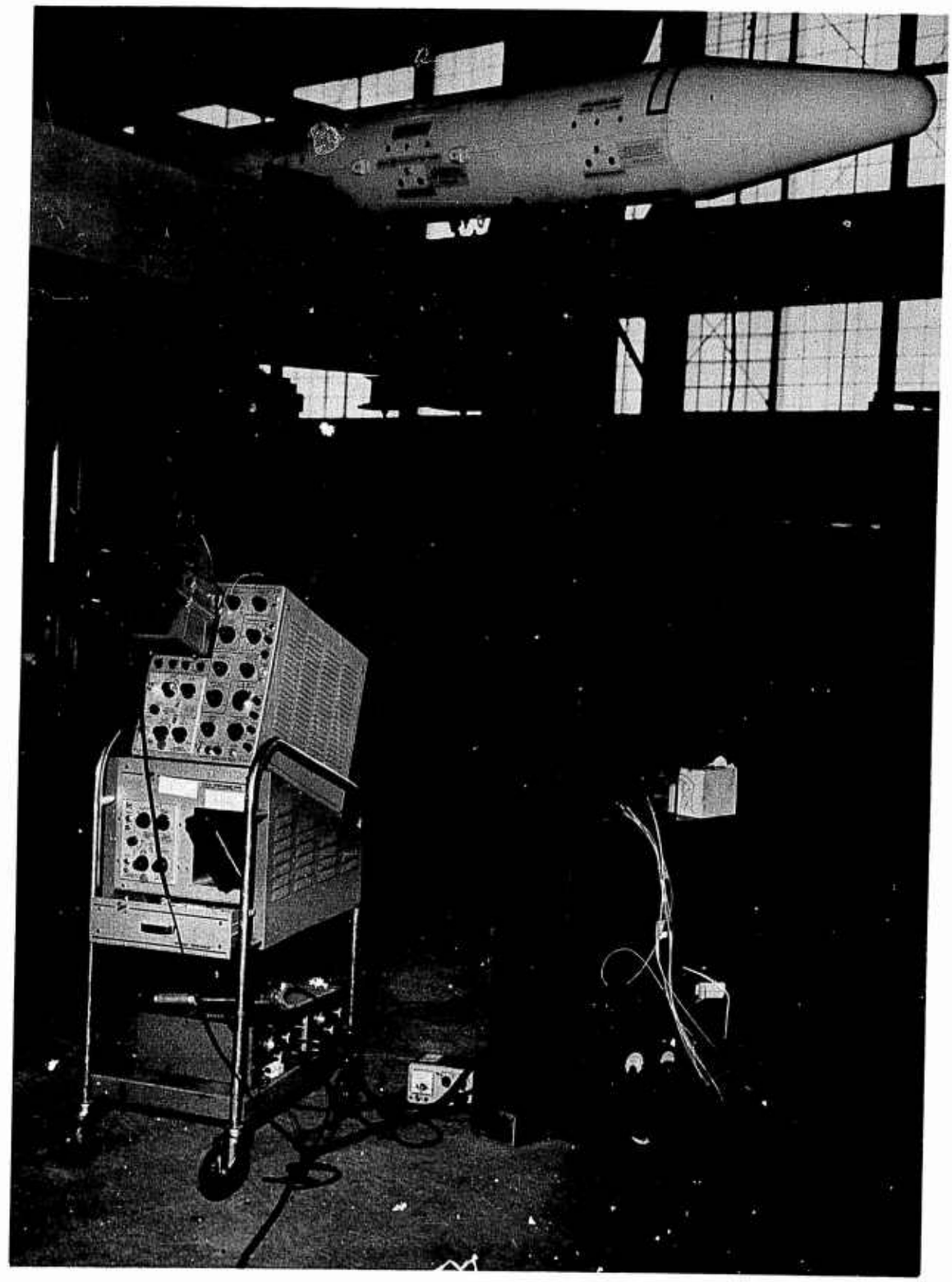

Figure 4. Shock tube apparatus

was decided advantageous to remove the rubber grommet surrounding the shaft of the Ledex switch on this trainer.

(b) The temperature shock test consists of exposing the test item to a temperature of 185°F for a period of 4 hours and immediately transferring it to a test chamber having a temperature of -40°F and allowing it to remain at this temperature for 4 hours. This sequence is repeated three times. At the conclusion of the third cycle of the test, the specimen was removed and operated in accordance with par. 4.5.3.2 of Mil-T-25812A. The trainer functioned properly.

(c) As a result of this test, it was concluded that the MN-1A trainer, as submitted for testing, may be expected to function satisfactorily after subjection to variations of temperature from 185°F to -40°F.

3. CONCLUSIONS.

a. The MN-1A trainer, as originally submitted, did not meet the requirements of Mil-T-25812A.

b. After modification by the Fairey Aviation Corporation the trainer successfully passed all tests with the exception of humidity.

c. Failures which occurred are considered to result from faulty design rather than poor manufacturing techniques.

4. RECOMMENDATIONS.

a. Modification of the ejector mechanisms should be made to ensure reliable operation under humid conditions.

b. The use of stiffer linkage springs and lubricant should be investigated.

c. The Fairey Aviation Corporation should be recognized as a technically qualified manufacturer of the MN-1A Trainer.

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1. Bombing techniques
2. Environmental testing
3. Flight testing
4. Practice bombs
5. Shock testing
6. Test equipment
7. Vibration testing
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Air Force Special Weapons Center, Kirtland AF Base, New Mexico
Rpt No. AFSWC-TDR-63-62. PREPRODUCTION TESTING OF THE FAIREY AVIATION MN-1A PRACTICE BOMB DISPENSER. July 1963. 21 p. incl illus.

Unclassified Report

Testing of the Fairey Aviation Corporation MN-1 Trainers was performed by AFSWC at the request of the Royal Canadian Air Force, for the purpose of establishing the Fairey Aviation Corporation as a qualified producer of the MN-1A Trainer. The tests were made in general accordance with Mil-25812A and Mil-E-5272C, and included vibration, acceleration, and shock testing, and exposure to certain climatic conditions critical to the operation of the dispensers. Three sample trainers, numbered FAC-1, FAC-2, and FAC-3, were used.

1. Bombing techniques
2. Environmental testing
3. Flight testing
4. Practice bombs
5. Shock testing
6. Test equipment
7. Vibration testing

I. AFSC Project ESP921X-0000-02150 OA
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